

Frequency and clinical features of cockroach sensitivity in atopic children

Cockroach sensitivity in atopic children

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Abstract

Aim: *Blattella germanica* (Bg) is the most common type of cockroach in Turkey. Although Bg is most commonly associated with respiratory allergic diseases in pediatric patients, it may cause a variety of allergic diseases. The aim of this study was to determine the prevalence of Bg in atopic children and to evaluate the clinical and laboratory findings in these patients.

Material and Methods: This study was conducted in the Pediatric Allergy outpatient clinic of Dr. Behçet Uz Pediatrics and Surgery Training and Research Hospital between 15.03.2022 and 10.04.2023. We analyzed children aged 2-18 years who underwent skin prick testing for aeroallergens, due to the presence of allergic disease symptoms. Next, we determined the prevalence, clinical and laboratory findings of Bg sensitization.

Results: Bg sensitivity was detected in 74 (5.45%) of 1358 atopic patients. The median age of Bg-sensitive patients was 8 (min-max:4-17), 33 (44.6%) of them were girls. Bg monosensitization was significantly more frequent in patients with cockroaches in their homes compared to those without (8.1% vs. 2.7%, $p=0.012$). Despite being told about household precautions, more than half of the patients had not performed any indoor pest control.

Discussion: Our study is the most comprehensive current study on cockroach sensitization and clinical findings in Turkish children. Measures against aeroallergens are often difficult to implement. However, household measures for Bg can facilitate the treatment of atopic diseases. Therefore, it would be useful to identify Bg-sensitized patients and take simple and effective measures such as indoor pest control.

Keywords

Allergy, Asthma, Allergic Rhinitis, Children, Cockroach

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Introduction

Although there are thousands of cockroach species worldwide, the most common domestic cockroach species are German (*Blattella germanica*-Bg) and American (*Periplaneta americana*) cockroaches [1]. It is estimated that 15-60% of atopic individuals are susceptible to one of these cockroaches [2]. As in other European and temperate countries, the most common cockroach species in Turkey is *Blattella germanica* [3-6].

The main sources of Bg allergens are saliva, feces, eggs and shed skin [1,7]. Although asthma is most commonly emphasized in Bg-sensitized individuals, an association with other allergic diseases such as allergic rhinitis (AR) and atopic dermatitis (AD) has also been reported [8].

The aim of the present study was to determine the prevalence of Bg sensitization in children with allergic symptoms and to evaluate the clinical and laboratory findings in these patients.

Material and Methods

This retrospective cross-sectional study was conducted in the Pediatric Allergy outpatient clinics of SBÜ İzmir Dr. Behçet Uz Pediatrics and Surgery Training and Research Hospital between 15.03.2022 and 10.04.2023.

Population and definitions of diagnosis

Patients between the ages of 2-18 years who were clinically evaluated by allergists and underwent skin prick test (SPT) due to the presence of any allergic disease symptom and later diagnosed with Bg sensitization were included in the study.

Patient data were analyzed retrospectively. Demographic data, clinical features and laboratory findings (Total IgE and Absolute eosinophil counts) were recorded. The diagnosis of bronchial asthma, AR, AD, urticaria-angioedema (UAE) was recorded. Asthma was defined according to the Global Initiative for Asthma (GINA) guidelines, AR was defined according to the ARIA guidelines, AD was defined according to the revised Hanifin and Rajka criteria, and chronic UAE was defined as the presence of urticaria and/or angioedema lasting longer than 6 weeks [9-12].

Patients were classified into two groups: seasonal and perennial, according to the symptomatic period. Those who described seasonal symptoms were classified into four subgroups: summer, winter, fall and spring, according to the period of complaints.

All patients with Bg sensitization were advised on household precautions and disinfestation. At least one month after the SPT was performed, the patients were contacted by phone to find out whether their home had been disinfested or sprayed. Skin prick test (SPT)

SPT results performed at the time of presentation to our outpatient clinic were recorded. Pollens (*Grasses*, *Artemisia vulgaris*, *Betula alba*, *Olea europaea*), house dust mites (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*), animal dander (*Felis domesticus*, *Canis familiaris*, *Blattella germanica*), and mold (*Alternaria alternata*) allergens were used in SPT (Alk-Abello®, Hørsholm, Denmark). SPT was considered positive if the induration diameter of any allergen was 3 mm or more compared to the negative control. According to SPT, only Bg-positive patients were considered as monosensitized, and those with allergen sensitization in addition to *Blattella*

germanica were considered as polysensitized.

Ethics committee

Ethical approval was obtained from Izmir Katip Çelebi University Non-interventional Clinical Research Ethics Committee (Decision No: 0224), (Approval date: 2023-05-18).

Statistical analysis

The normality hypothesis was tested using the Kolmogorov-Smirnov test to decide the statistical methods to be used. Non-parametric test methods were used if any one of the groups did not meet normality assumptions. Accordingly, the Mann-Whitney U test or Student's t-test was used to compare numerical variables between two independent groups. Chi-square and Fisher exact tests were used to analyze the relationships between categorical variables. Statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS) for Windows, Version 25 and a p-value of ≤ 0.05 was considered statistically significant.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

Bg sensitization was detected in 74 (5.45%) of 1358 patients who applied to our pediatric allergy outpatient clinic and underwent SPT. Thirty-three (44.6%) of the patients were female and the median age was 8 years (min-max: 4-17). Symptoms were seasonal in 26 (35.1%) patients (winter in 14 (18.9%), spring in 9 (12.1%), and summer in 3 (4.1%) patients) (Table 1). There were 23 (31.1%) patients whose parents had allergic diseases. Five (6.8%) patients had pets at home and 11 (14.9%) patients had AD during infancy.

There were 24 (32.4%) patients who had cockroaches in their homes in the last 1 year. Bg monosensitization was significantly more frequent in patients with cockroaches in their homes compared to those without (8.1% vs. 2.7%, $p=0.012$). The data of patients with and without cockroaches in their homes are summarized in Table 1.

The most common diagnosis was AR. Figure 1 shows the distribution of allergic diseases.

According to SPT, monosensitization to Bg was detected in 8 (10.8) patients. The median age of these patients was 8 (min-max: 4-12) and 7 (87.5%) were male. Cockroaches were detected in the house of 6 (75%) of them. Other allergen sensitizations accompanying Bg sensitization are animal danders (71.6%), pollens (59.5%), house dust mites (45.9%), and molds (17.6%).

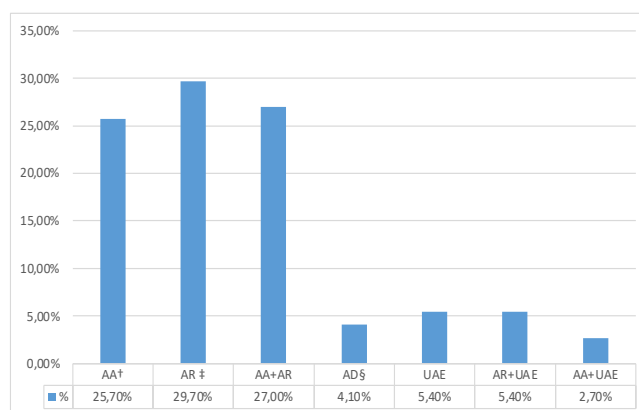


Figure 1. Distribution of allergic diseases detected in patients.

When mono- and poly-sensitized groups were compared, no difference was found in terms of gender, presence of asthma, and presence of AR ($p>0.005$).

When patients with and without asthma were evaluated, there was no difference in terms of gender, age, total eosinophil count, and the presence of other allergen sensitizations ($p>0.05$). Similarly, there was no significant difference between

the groups of patients with and without AR ($p>0.05$). T. IgE levels were significantly higher in patients with asthma compared to those without asthma ($p=0.002$) (Table 2).

Domestic precautions and disinfestation were recommended to all patients with cockroach sensitization. None of the patients had performed disinfestation before presenting to our clinics, and it was found that only 29 (39.2%) patients with Bg sensitization had their homes sprayed afterwards.

Table 1. Data of patients according to the presence of Cockroaches in their home

		Presence of cockroaches at home		p	Total
		Yes	No		
Sex n (%)	Male	17 (23)	24 (32.4)	0.102	41 (55.4)
	Female	7 (22.5)	26 (35.1)		
Median Age (min-max)		8 (4-16)	9 (4-17)	0.283	8 (4-17)
Symptom time	Perennial n (%)	20 (27.1)	28 (37.8)	0.021	48 (64.9)
	Seasonal n (%)	4 (5.4)	22 (29.7)		
Diagnosis n (%)	Asthma	17 (23)	24 (32.4)	0.064	41 (55.4)
	Allergic rhinitis	12 (16.2)	34 (45.9)	0.135	46 (62.2)
	Atopic dermatitis	1 (1.4)	2 (2.7)	1.000	3 (4.1)
	Urticaria and/or angioedema	5 (6.8)	5 (6.8)	0.029	10 (13.6)
Sensitization n (%)	Monosensitization	6 (8.1)	2 (2.7)	0.012	8 (10.8)
	Polysensitization	18 (24.3)	48 (64.9)		
Accompanying allergen†	House dust mites	7 (9.4)	27 (36.5)	0.045	34 (45.9)
	Pollens	12 (16.2)	32 (43.3)	0.251	44 (59.5)
	Animal danders	15 (20.2)	38 (51.4)	0.228	53 (71.6)
	Molds	4 (5.4)	9 (12.2)	0.888	13 (17.6)
	Total IgE (IU/mL) median (min-max)	201.5 (4.83-2000)	191 (2.87-2000)	0.591	191 (2.87-2000)
AEC‡ (cells/uL) median (min-max)	260 (20-1010)	280 (40-1140)	0.991	280 (20-1140)	

†, According to skin prick test; ‡, Absolute eosinophil count

Table 2: Clinical and laboratory characteristics of patients with asthma and AR

		Asthma		p	Allergic Rhinitis		p
		Yes	No		Yes	No	
Sex n (%)	Male	25 (53.8)	16 (21.6)	0.283	28 (57.8)	13 (17.6)	0.225
	Female	16 (21.6)	17 (23)		18 (24.3)	15 (20.3)	
Median Age (min-max)		8 (4-16)	8 (4-17)	0.650	10 (4-17)	8 (4-16)	0.066
Symptom Time n(%)	Perennial	29 (59.2)	19 (25.7)	0.239	33 (44.6)	15 (20.3)	0.112
	Seasonal	12 (16.2)	14 (18.9)		13 (17.6)	13 (17.6)	
Sensitization n(%)	Monosensitization	3 (4.1)	5 (6.8)	0.454	4 (5.4)	4 (5.4)	0.453
	Polysensitization	38 (51.4)	28 (37.8)		42 (56.8)	24 (32.4)	
Accompanying allergens† n(%)	House dust mites	21 (28.4)	13 (17.6)	0.310	22 (29.7)	12 (16.2)	0.677
	Pollens	23 (31.1)	21 (28.4)	0.511	29 (39.2)	15 (20.3)	0.421
	Animal danders	32 (43.2)	21 (28.4)	0.172	34 (45.9)	19 (25.7)	0.575
	Molds	10 (13.5)	3 (4.1)	0.086	7 (9.5)	6 (8.1)	0.496
Total IgE (IU/mL) median (min-max)		287 (56.5-2000)	123 (2.87-1190)	0.002	182 (2.87-2000)	123 (51.5-1732)	0.409
AEC‡ (cells/uL) median (min-max)		280 (90-1140)	230 (20-1010)	0.118	235 (20-780)	280 (90-1140)	0.475

†, According to skin prick test; ‡, Absolute eosinophil count

Discussion

Sensitization rates to cockroach allergens vary widely across countries and regions. In the present study, *Blatella germanica* sensitization was detected in 5.4% of pediatric patients with allergic disease. Although Bg monosensitization was found in only 10.8% of the patients, unlike the literature, animal dander was the most common aeroallergen sensitization accompanying Bg sensitization. The incidence of cockroaches in the home was higher among patients with Bg monosensitization. The most common symptoms in Bg monosensitized or polysensitized patients were respiratory symptoms. In addition, it was found that symptoms persisted throughout the year in patients who had Bg at home.

In regions with temperate, cool and dry climates such as Europe and the United States of America (USA), the German cockroach (Bg) is the most common species [13]. Two studies reported that the sensitization rate among atopic children was 20.6 % in Iran and 7.5% in Norway [14,15]. Data assessing cockroach sensitization in childhood in Turkey are insufficient. In a few studies, limited data identified during general atopy assessment have been reported in the literature. In one of the comprehensive studies conducted in Turkey, 1382 pediatric patients aged 0-12 years with atopy were evaluated and Bg sensitization was detected in 2.7% of the patients. All patients sensitized to *Blatella germanica* were polysensitized, and house dust mite sensitization most commonly accompanied Bg sensitization [5]. In another study evaluating 337 pediatric patients aged 2-16 years, Bg sensitization was detected in 11.9% of the patients. Bg monosensitization was detected in only 1% of these patients. It was reported that *Blatella germanica* sensitization was most commonly accompanied by house dust mite sensitization [16].

It has been reported that exposure increases with inhalation of cockroach allergens in house dust, and respiratory allergic diseases may develop [1,7]. Cross-sensitization between mites and cockroach allergens has also been reported [17]. However, no cross-reactivity between animal allergens and cockroach allergens has been reported in the literature. Sensitization rate to animal allergens was higher in our Bg sensitized patients, which may be due to a higher rate of animal contact.

Cockroach sensitization has been reported to be common in asthmatic children. It has been reported that cockroach allergens cause IgE reactivity associated with the presence of asthma and rhinitis, and exposure to cockroach allergens is strongly associated with increased hospitalization in children with asthma [18,19]. Approximately 25% of asthmatic children in Poland, 58% of asthmatic patients in Taiwan and 60-80% of asthmatic children in the United States of America were found to be sensitive to cockroaches [20-22]. Canitez and Cicek [5]

reported a diagnosis of asthma in 69.4%, AR in 38.9%, AD in 10.8%, and urticaria in 13.5% of Bg-sensitized patients. In the present study, Bg-sensitized patients were most commonly diagnosed with AR (62.2%), followed by asthma (55.4%). The frequency of UAO (13.5%) was similar to the literature, while AD (4.1%) was less common. Multiple allergen sensitization was common in patients with and without asthma and/or AR, and no significant difference was found in terms of concomitant allergens. Total IgE levels were significantly higher in Bg-sensitized patients with asthma compared to those without asthma.

It is recommended to reduce environmental allergen exposure in the homes of patients with cockroach-induced allergic disease [23]. We also recommend indoor pest control at least once a year, not leaving garbage and food waste outdoors, preventing cracks and dampness in the building, and using insect nets for windows and doors in patients with Bg sensitization.

However, it was found that less than half of Bg-sensitized patients performed indoor pest control despite our recommendations.

The biggest limitation of the present study is that it was designed retrospectively. Therefore, long-term follow-up of the patients could not be performed.

Conclusions

Detection of sensitization is important to reduce the risk of cockroach-related allergic diseases. Reducing environmental allergen exposure through simple household measures can lead to symptom improvement. This can improve patients' quality of life and reduce the burden of treatment. From this perspective, supporting patients to take simple and effective measures such as indoor pest control can be highly effective.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of interest

The authors declare no conflict of interest.

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